Staff Report

Agenda Item: **Joint Funding Agreement with the United States Geological Survey (USGS) for Water Resources Investigations** - Approval of the Joint Funding Agreement provides the mechanism for the Town to provide a sub-grant to the Verde River Basin Partnership/USGS for the Walton Family Foundation Grant.

Submitted By: Town Manager Gayle Mabery

Meeting Date: August 31, 2010

Background: At the July 13, 2010 Council meeting, the Town Council approved an 18 month grant from the Walton Family Foundation in the amount of $475,651 to:

a) Establish the Initial Project Management Team for the Clarkdale Sustainability Park ($225,250);
b) Provide a sub-grant to the Verde River Basin Partnership/USGS to collect and analyze critical data and publish a report on water budgets and water resources needed by area resource managers to make informed management decisions ($247,922); and,
c) Act as the pass-through agency for the sub-grant, and collect and administrative fee to do so ($2,479).

The US Department of the Interior requires the execution of a Joint Funding Agreement in order to facilitate the sub-grant to the USGS. The Joint Funding Agreement provides the mechanism for the Town to receive billing from USGS, and for the Town to pay those billings.

Recommendation: Staff recommends that the Council approve the Joint Funding Agreement with the USGS for Water Resources Investigations.

Form 9-1366
(Oct. 2005)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	AZ083
Agreement #:	10W4AZ03700
Project #:	9671EAX
TIN #:	86-6005840
Fixed Cost Agreement	☑ Yes ☐ No

FOR
WATER RESOURCES INVESTIGATIONS

THIS AGREEMENT is entered into as of the 20th day of July, 2010, by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the TOWN OF CLARKDALE, party of the second part.

1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation an investigation of the middle Verde Watershed in accordance with the attached workplan, herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of $0.

(a) $50,000.00 by the party of the first part during the period September 1, 2010 **to** February 29, 2012

(b) $247,922.00 by the party of the second part during the period September 1, 2010 **to** February 29, 2012

(c) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.

(d) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.
7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

Form 9-1366 continued	U.S. Department of the Interior U.S. Geological Survey Joint Funding Agreement	Customer #: Agreement #: Project #: TIN #:	AZ083 10W4AZ03700 9671EAX 86-6005840

8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at costs, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.
9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered **quarterly**. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983).

U.S. Geological Survey
United States
Department of the Interior

Town of Clarkdale
P.O. Box 308
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Signatures

By [signature] Date 07/20/10
Name: John P. Hoffmann
Title: Acting Director

By _____ Date _____
Name:
Title:

By _____ Date _____
Name:
Title:

Signatures

By _____ Date _____
Name: Doug Von Gausig
Title: Mayor

By _____ Date _____
Name: Gayle Mabery
Title: Town Manager
ATTEST:

By _____ Date _____
Name: Kathy Bainbridge
Title: Town Clerk

Work plan to collect essential data and develop a water budget and groundwater use scenario report for a portion of the middle Verde Watershed, Arizona

Introduction

The U.S. Geological Survey (USGS), in conjunction with the Verde River Basin Partnership (Partnership), will collect and analyze critical data and publish two reports consistent in outcome with the first deliverable specified under Title II of Public Law 109-110, the Northern Arizona Land Exchange, Title II and Verde River Basin Partnership Act of 2005.

The first deliverable specified in Title II (wording from Title II below in italics) is a report delivered by the USGS to the Partnership within 14 months from the beginning of work, a Verde Valley water-budget analysis that includes:

> *(A) a summary of the information available on the hydrologic flow regime for the portion of the Middle Verde River from the Clarkdale stream*
> *gauging station to the city of Camp Verde at United States Geological Survey Stream Gauge 09506000;*
> *(B) with respect to the portion of the Middle Verde River described in subparagraph (A), estimates of--*
> *(i) the inflow and outflow of surface water and groundwater;*
> *(ii) annual consumptive water use; and*
> *(iii) changes in groundwater storage; and*
> *(C) an analysis of the potential long-term consequences of various water use scenarios on groundwater levels and Verde River flows.*

This study and its resulting two reports will provide essential information on water budgets and water resources needed by area resource managers to make informed management decisions. Additionally, the reports will serve to codify and articulate significant gaps in the status of hydrologic knowledge in the Verde Valley in order to guide the formation of future studies. Because the reports are funded outside the federal Title II process, the Title II timelines do specifically not apply. The importance is recognized, however, of providing information for the area's resource managers that is both timely and complete. In order to satisfy both these requirements, the effort time is 18 rather than 14 the months specified for the first deliverable in Title II.

Background

In fulfillment of the first requirement of Title II, the Partnership and USGS collaborated to write a plan, subsequently updated in September 2009, and called the Hydrology Science Plan, which identified *specific studies and analyses needed to support water-resource planning and management needs for the Verde River Basin*, including the duration and costs of the needed studies. The Hydrology Science Plan was written for a 4-year project horizon and includes elements that directly address the specific deliverables required in Title II including a report concerning the water budget of the Verde Valley (figure 1). Owing to its 4-year horizon, the Hydrology Science Plan included data collection elements that would not benefit the first deliverable, but would yield improved understanding of the hydrogeologic system for the final deliverable. The work specified here differs from the Hydrology Science Plan inasmuch as only elements that specifically constrain the water budget in the Verde Valley and can be completed in the established 18 month time-frame are included.

In the time since the Hydrology Science Plan was conceived and completed, several studies with relevance to constructing a water budget of the Verde Valley have been conducted or are nearing completion. Of greatest importance for the effort described here is the completion and pending publication by the USGS of the Northern Arizona Regional Groundwater Flow Model (NARGFM). Although the modeled area is much larger than the Verde Valley, this model synthesizes much of the important hydrologic and hydrogeologic information into a powerful tool that can be used for evaluation of the Verde Valley water budget and the effects of pumpage on Verde River flow both entering and leaving the Verde Valley. The planned work, with detailed emphasis on the Verde Valley, and complemented by maps showing the simulated effects of groundwater withdrawals and artificial recharge for the Verde Valley that are also in preparation by the USGS in cooperation with the Nature Conservancy, promises to provide a new and compelling basis for the evaluation of the long-term strengths and limitations of the Verde Valley's water supply. Although the exact timing of impacts of various water-management strategies is expected to be variably constrained, depending on the data that were available in a particular location to construct the model, the long-term effects of these strategies are expected to be clear.

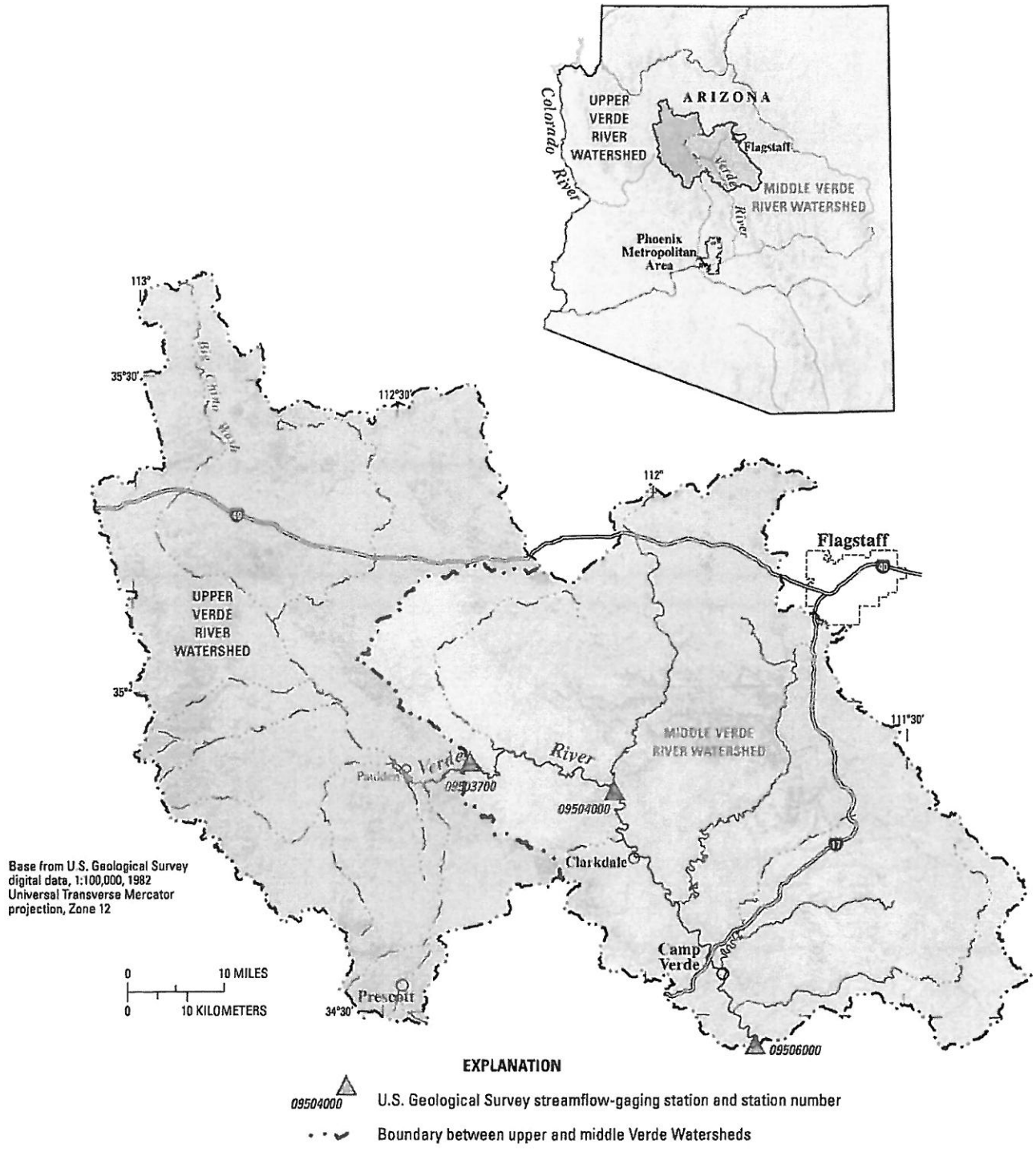

Figure 1. Map of the upper and middle Verde River watersheds showing the locations of USGS streamgages (triangles) and identifying specifically the Verde River near Clarkdale (09504000) and Verde River near Camp Verde (09506000) gages.

Objective

This work has three objectives: (1) to draw from existing reports and collect new data to construct a water budget specific to the middle Verde Watershed defined by the watershed area between USGS streamflow gaging stations Verde River near Clarkdale (09504000) and Verde River near Camp Verde (09506000), (2) to conduct a groundwater-model analysis of the possible results of three scenarios of upgradient development on Verde River streamflow and groundwater levels within the middle Verde Watershed, and (3) to publish two reports specific to the defined study area, one written to describe the science conducted, and one written to inform the lay-public including the stakeholders represented in the Verde River Basin Partnership and the resource managers of the area. The reports will include the analysis of the implications of three water-use scenarios on groundwater levels in the middle Verde Watershed and base flow in the Verde River.

Approach

The approach includes two key aspects:

1) Extraction and interpretation of data from existing reports, models, and analyses to create a water budget specific to the watershed area between the USGS streamflow gaging stations Verde River near Clarkdale (09504000) and Verde River near Camp Verde (09506000) and an assessment of the implications of various water-use scenarios on Verde River flows and groundwater levels.
2) Collection and analysis of focused field data that can be completed within the 18-month timeframe of the project and which have direct bearing on improving the water budget in the watershed area between the two USGS streamflow gaging stations.

These two aspects of work will be accomplished through completion of the following tasks:

Task A. Compilation and interpretation of existing published information

The USGS will compile and review all available current water-budget information pertinent to the middle Verde Watershed with a focus, as specified in the Hydrology Science Plan, on the portion of the middle Verde River Watershed from the USGS Verde River near Clarkdale stream gage 09504000

to the USGS Verde River near Camp Verde stream gage 09506000. Existing information, however, generally does not apply to the specific geographic area of this study but rather partly overlaps or extends beyond the study-area boundaries. As a result, an important aspect of this task is interpreting water-budget information from previous work in order to customize values for the defined subarea in the middle Verde Watershed. In addition, water budgets from existing works contain values that represent various times. The effort included in this task will consider the implications of mixing water-budget values derived for different points in time and determine the best mix of published values to represent the defined subarea in the middle Verde Watershed in a baseline water-budget year of 2005.

Much information exists in published reports and has been recently compiled and synthesized in the USGS NARGFM, simplifying the task in this proposal. Among the reports relevant to the middle Verde Watershed: Levings (1980) described groundwater availability and water chemistry in the Sedona area; Owen-Joyce and Bell (1983) presented findings of a water-resource appraisal in the Verde River Area from Sullivan Lake to Fossil Creek and includes a water budget for the area; and Owen-Joyce (1984) describes the hydrology of the stream-aquifer system near Camp Verde and includes a water budget for the alluvial aquifer hydraulically connected to the river. The Arizona Department of Water Resources (ADWR) (2000) compiled a summary of available water-resource data in the upper and middle Verde River watersheds. Most recently, Blasch and others (2006) presented a regional evaluation of the hydrogeologic setting of the upper and middle Verde River watersheds, including water-budget data and estimates through 2003.

Task B. Use of NARGFM to provide specific water-budget information

A groundwater model is ideally suited to provide water-budget information. Although NARGFM simulates an area much larger than the middle Verde Watershed, it was constructed with particular focus on addressing water-resource issues in the Verde River Basin. For this task, NARGFM will be used to extract modeled water-budget values for the geographic area that corresponds to the study-area bounds, in essence customizing a water budget to the area. The water-budget analysis for the subarea of the middle Verde Watershed will include: (i) the inflow and outflow of surface water and groundwater, (ii) annual consumptive water use, and (iii) changes in groundwater storage. The

baseline year for the water-budget analysis will be determined by the final year simulated in NARGFM, 2005.

Task C. Evaluation of potential long-term consequences of water-use scenarios

The NARGFM was constructed as a best-available representation of the flow of water through the aquifer systems of Northern Arizona. That representation includes not only the amount of water that enters and exits the aquifers (the water budget), but also how the flow of water responds to stresses to the system such as withdrawals by wells. Two ongoing efforts are employing NARGFM to estimate responses of the aquifer system to groundwater pumping. The first is an analysis of system responses to three groundwater pumping scenarios provided by the Yavapai Water Advisory Committee (WAC). The second is the development of maps that plot the response of surface water features to groundwater pumping as a function of geographic location and depth of pumping for 10 and 50 years. For the purpose of these reports, the time horizon of the response maps will be extended to 100 years and those maps and (or) tabular results will be included.

An initial set of three different water-use scenarios projected to year 2050 for the entire area of the upper and middle Verde watersheds has been supplied to the USGS by the WAC. Appreciable effort was invested in these scenarios, which represent a range of water-demand possibilities and have been sanctioned as appropriate by Yavapai County and the representatives of all of the incorporated communities of Yavapai County in the upper and middle Verde River watersheds and the Prescott Active Management Area. The USGS has committed to produce NARGFM simulations for these three scenarios for the WAC. This project will simulate the same scenarios with the NARFGM with particular emphasis on the middle Verde Watershed and long-term impacts on the area's water supply. Although the scenarios supplied for Yavapai County WAC are specified to 2050, the scenarios for this project will be simulated for 100 years (to 2110) using the 2050 pumping values and other assumptions in the Yavapai County WAC scenarios held constant for the 2050–2110 period.

An important limiting factor for the long-term water supply of the study area is base flow entering the middle Verde watershed at the Paulden stream gage 09503700 plus the groundwater flow around the gage. The groundwater model allows estimation of expected changes in groundwater levels and flows, and Verde River flows that may result from past and future pumping throughout the upper and middle

Verde watersheds. The combination of future pumping scenarios run in the groundwater model together with the simulated effects on surface-water flows will provide valuable information for water management in the middle Verde Watershed. The products resulting from this project will synthesize these analyses and their results with a particular focus on the implications for the water supply in the middle Verde Watershed. Specifically changes in base-flow values at key locations along the Verde River within the middle Verde Watershed predicted as part of the scenario analysis will be described and presented in the project report products. In addition, map figures that indicate projected groundwater-level changes at the watershed scale will be presented.

Task D. Collection and analysis of field data directly applicable to constraining the water budget

Associated with the development of NARGFM, the types and locations of additional data were identified that would enhance hydrogeologic understanding, including the water budget. In particular, it was determined that a better understanding of flows and uses of water in the shallow system in the vicinity of the Verde River, including agricultural and riparian uses, is an important component in constraining the water budget. Several additional efforts combined with the results of an ongoing study of irrigation diversions along the Verde River will be conducted and applied to the water-budget analysis.

Subtask D1 Quantification of diversions of Verde River flow for agriculture

Diversions of streamflow for irrigation between the towns of Clarkdale and Camp Verde represent an important component of the area's water budget. A detailed study in progress by researchers at Northern Arizona University (NAU) offers improved quantification of the irrigation diversions. These new data will be applied insofar as possible to refine the water-budget analysis.

Subtask D2 Development of remotely sensed agricultural and riparian evapotranspiration

Evapotranspiration by crops and riparian plants is an important and large component of the overall water budget along the Verde River between the Clarkdale and Camp Verde streamflow-gaging stations. Relatively small errors in relatively large water budget components result in large overall errors in a water-budget analysis. As a result, there is significant benefit in better constraining the water use of agricultural and riparian plants.

For this analysis, remotely sensed MODIS satellite data that provide an index of greenness will be used to calculate actual evapotranspiration of groundwater along the Verde River between the Clarkdale and Camp Verde streamflow-gaging stations. The analysis relies on correlations between greenness and evapotranspiration developed by Nagler and others (2009a and 2009b) among others. Satellite passes occur every 16 days, resulting in very good temporal resolution. Spatial resolution of the MODIS data pixels is 250 x 250 meters.

The MODIS datasets in the middle Verde Watershed for 2000 to 2007 have been compiled as part of an earlier USGS project and their analysis has been partially completed. For this work, USGS will update the datasets and analysis with the most recent available satellite data.

Subtask D3 Field verification of consumptive agricultural water use

A critical complement to the remotely sensed estimates of evapotranspiration from agricultural water use is field verification and analysis to provide an independent means of corroborating results. While the remotely sensed analysis uses data based on a 250-meter pixel resolution, the field verification relies on visits by USGS personnel who take photos and notes concerning the types of crops being grown and the way irrigation water is applied. The field notes are then mapped into a GIS database using available high-resolution aerial photography to allow accurate calculation of the number of acres of a specific crop or grass being grown at the time of analysis. Consumptive water use is calculated using a modified Blaney-Criddle method that considers latitude, average monthly temperature, total monthly precipitation, crop type, and crop planting and harvesting dates.

As part of an existing cooperative water-use program between the USGS and ADWR, a field verification analysis is already scheduled and funded for the middle Verde Watershed in the summer of 2010 independent of this project. For the purpose of this more detailed analysis of agricultural water use, a winter analysis will be added to provide a more complete view of year-round use. Even at times when crops may not be planted, pasture grasses may be watered – the planned work will quantify this use.

Subtask D4 Fall-Winter base-flow analysis

A seepage investigation involves the measurement of stream base flow at multiple locations along a stream in as short a time as possible. The intent is to develop a detailed snapshot regarding the locations and amounts of water that enter and leave a stream along its length including both stream-aquifer interactions and agricultural diversions and returns. Such information improves understanding of the stream's water budget as well as how effectively and where a stream is connected to its underlying aquifer.

An estimated 35,000 acre-ft of water is diverted for agricultural use each year; however, the uncertainty of this number is considered large. Data collected in the summer of 2007 at about 75 sites from the USGS gage near Clarkdale (09504000) to Beasley Flat and at about 12 sites on Oak Creek, Beaver Creek, and West Clear Creek are comparable with data collected by Owens-Joyce and Bell (1983) in 1978 and indicate differences in the base-flow component of the Verde River and its tributaries. Among these differences are significantly less measured base flow and better definition of gaining and losing reaches of the river despite the unmeasured ditch diversions, return flows, and near maximum evapotranspiration. To develop a better understanding of how the Verde River is interconnected to groundwater, we will conduct a second synoptic streamflow survey during winter base flow when evapotranspiration is at a minimum and many of the ditches are minimally operating. This will allow better constraint on inflows and outflows of surface water and groundwater along the course of the Verde River and its tributaries. These data are necessary to refine water budgets for the Verde River system.

A reconnaissance survey will be conducted in the late summer of 2010 to determine access to sites measured in 2007 and determine which ditch operations will still have an impact on the survey. The reconnaissance survey will also evaluate the gaining and losing reaches defined in the 2007 survey to determine their suitability for geophysical surveys and collection of continuous temperature data. Because many of the ditches will not be in operation it is expected that the number of measurement sites on the Verde River can be reduced from 76 to about 40. The continuous record of ditch diversions and return flows collected by NAU researchers over approximately an 18 month period on the Verde, OK, Diamond S, Hickey, and Eureka ditches will help to constrain diversions and return flows if these ditches are operating during the

survey. Discharge measurements will be made at a number of sites measured in the 2007 survey, and additional discharge measurements will be made at gaining and losing reaches to better define inflows and outflows of stream flow and groundwater.

The base-flow survey of the Verde River will be conducted over a single 5-day period during base-flow conditions within the period from November to February. Seven teams of 2 people traveling by boat or by vehicle will collect discharge, field parameters, and physical characteristic data at each of about 50 sites on the Verde River from the USGS gage near Clarkdale (09504000) to the USGS gage near Camp Verde (09506000, Verde River abv. Chasm Creek). In addition, all sites will be photographed and geolocated using GPS to ensure comparability of site data with past surveys. At 10 sites on the Verde, randomly selected, two discharge measurements will be made so that the uncertainty with the discharge data can be assessed. This will be needed to assess whether changes in discharge in a reach are due to inflows/outflows or due to measurement error. The USGS will conduct the base-flow survey during a time when use of ditches on the Verde River is at a minimum. Since the Verde River ditches are never entirely shut off, the USGS will use, as much as possible, information from NAU and The Nature Conservancy on ditch inflows and return flows to reduce uncertainty in the base flow measurements. It still may be necessary however, to measure or verify ditch and return flows at a number of sites. This would require no more than 40 additional measurements. It is anticipated that data will be collected at up to 90 total sites as part of this synoptic survey.

Communication and Reporting

Cooperator engagement

The success of this project relies not only on the technical expertise of USGS staff, but also on regular communication between USGS scientists and the Partnership. This communication will be bidirectional, serving both as a means for USGS to share ongoing progress and results, and for USGS staff to tap the technical expertise of the Hydrology Subcommittee of the Partnership's Technical Advisory Group. Meetings will be held at least quarterly.

Reporting

The USGS, in collaboration with the Partnership, will produce two published reports. The first will be a USGS-series scientific manuscript that describes the methods and results of the study including the data, the limits and application of the data, and the conclusions with respect to long-term water supply of the middle Verde Watershed under the posited water-management scenarios. The first report will also include recommendations for enhancement of the NARGFM to improve its utility for guiding water-management decisions.

In addition to a technical purpose, the results of this project are intended to serve as a key building block in both defining future studies and establishing a well-documented basis for consideration by citizens and elected officials of the long-term potential and limitations of the water supply in the middle Verde Watershed. To serve the latter purpose a second report will be published that is based on the science described in the first report, but written specifically to be understood by nonscientists. This second report will be published as a 4 to 6 page USGS Fact Sheet authored by USGS scientists and, if provided by the cooperator, a professional writer.

The USGS recognizes the importance of topically-simplified outreach products describing results of this project and will work with project cooperators to review the technical accuracy of cooperator-authored documents. Both reports will be electronically released through Persistent URLs that will be broadly and publically accessible. No printed report copies are planned or budgeted, but could be added after project completion.

Outreach

Synchronous with the release of reports, USGS will prepare an oral presentation describing the project approach and results. This presentation will be aimed at the lay-audience and will be given, by request, to the Partnership, to local government councils and committees, and to stakeholder groups.

Timeline

The study is planned for an 18 month horizon from initiation on September 1, 2010 to completion of report on February 29, 2012. A Gantt chart (Table 1) outlines the project schedule by task item.

Table 1. Planned project timeline by task

		Calendar Year																			
		2010				2011														2012	
Task	Description	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F		
A	Compile, interpret existing data																				
B	Use model to derive water-budget information																				
C	Evaluation of water-use scenarios																				
D1	Diversion quantification†																				
D2	Remote ET analysis																				
D3	Field water-use confirmation																				
D4	Seepage run																				
	Report																				

†Incorporation of results in this study from a Northern Arizona University study on diversions from the Verde River.

Budget

The project budget (table 2) includes estimated project costs grouped by task item. The project is planned over an 18 month period and will span three federal fiscal years. Salary, travel, equipment, and other expenses are specified within task budgets. Personnel assigned to the project include a GS-13 hydrologist for groundwater modeling and report writing, a GS-9 hydrologist for data compilation, a GS-11 hydrologist for remotely sensed evapotranspiration analysis, a GS-12 hydrologist and GS-5 student (task D3, various personnel) for field verification of water use. The fall-winter base-flow analysis is a labor intensive task, and is expected to require the participation of about 14 hydrologists and hydrologic technicians for the field campaign as well as a GS-12 (task D4, various personnel) hydrologist to oversee all aspects of the task including planning, data collection, quality assurance, interpretation, and archiving.

A breakdown of funding between cooperator and USGS matching is provided in table 3.

Table 2. Estimated total project costs by task and spanning the full 18 month project period

Task	Description	Hours	Personnel	Hourly Rate	Cost
A	Compile, interpret existing data (Labor)	160	GS-9 hydrologist	$48	$7,706
B	Use model to derive water-budget information (Labor	40	GS-13 hydrologist	$91	$3,646
C	Evaluation of water-use scenarios (Labor)	80	GS-13 hydrologist	$91	$7,292
D1	Diversion quantification†	40	GS-9 hydrologist	$48	$1,920
D2	Remote ET analysis (Labor)	160	GS-11 hydrologist	$67	$10,733
D3	Field water-use confirmation				
	Labor		Various		$8,000
	Travel				$4,710
	Vehicle				$1,290
D4	Seepage run				
	Labor		Various		$81,535
	Travel				$20,000
	Vehicle				$6,880
	Supplies				$8,600
	Equipment Rentals				$8,000
Report	Writing, review, and publishing				
	Labor	1,253	GS-13 hydrologist	$91	$114,210
	Enterprise Pubishing				$13,400
	Total				**$297,922**

†Hours indicated here are for interpretation and incorporation of results in this study from a Northern Arizona University study on diversions from the Verde River.

Table 3. Funding source distribution by federal fiscal year

Fund Source	Fiscal year 10	Fiscal Year 11	Fiscal Year 12	Total
Cooperator	$12,730	$198,142	$37,050	$247,922
USGS Match	$0	$39,427	$10,573	$50,000
Total	$12,730	$237,569	$47,623	$297,922

References:

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Blasch, K.W., Hoffmann, J.P., Graser, L.F., Bryson, J.R., and Flint, A.L., 2006, Hydrogeology of the upper and middle Verde River watersheds, central Arizona: U.S. Geological Survey Scientific Investigations Report 2005–5198,102 p., 3 plates.

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Levings, G.W., 1980, Water resources in the Sedona area Yavapai and Coconino Counties, Arizona: Arizona Water Commission Bulletin 11, 37 p.

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Nagler, Pamela L., Kiyomi Morino, Edward P. Glenn, Richard S. Murray, Kevin R. Hultine, John Osterberg. 2009b. Saltcedar (Tamarix spp.) water use and ecohydrological niches on the lower Colorado River. Coming Together: Coordination of Science and Restoration Activities for the Colorado River Ecosystem. Proceedings from the Colorado River Basin Science and Resource Management Symposium. Scottsdale, AZ. November 18-20. In Press.

Owen-Joyce, S.J., and C.K. Bell, 1983, Appraisal of Water Resources in the Upper Verde River Area, Yavapai and Coconino Counties, Arizona, Arizona Department of Water Resources Bulletin 2, Prepared by the U.S. Geological Survey, 219 p.

Owen-Joyce, S.J., 1984, Hydrology of a stream-aquifer system in the Camp Verde area, Yavapai County, Arizona: Arizona Department of Water Resources Bulletin 3, 60 p.